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PATENT COOPERATION TREATY

PCT

NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

BUCHANAN, Elspeth, Victoria
P.L. Berry & Associates
P.O. Box 1250
Christchurch
NOUVELLE-ZÉLANDE

29 FEB 2000

Date of mailing (day/month/year) 10 February 2000 (10.02.00)		
Applicant's or agent's file reference 10571		IMPORTANT NOTICE
International application No. PCT/NZ99/00114	International filing date (day/month/year) 26 July 1999 (26.07.99)	Priority date (day/month/year) 28 July 1998 (28.07.98)
Applicant GOATLEY, Ernest, Paul		

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU,CN,EP,IL,JP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,
HU,ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,OA,PL,PT,RO,RU,SD,
SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZA,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
10 February 2000 (10.02.00) under No. WO 00/06927

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

BUCHANAN, Elspeth, Victoria
P.L. Berry & Associates
P.O. Box 1250
Christchurch
NOUVELLE-ZÉLANDE

Date of mailing (day/month/year) 10 February 2000 (10.02.00)		IMPORTANT INFORMATION	
Applicant's or agent's file reference 10571			
International application No. PCT/NZ99/00114	International filing date (day/month/year) 26 July 1999 (26.07.99)	Priority date (day/month/year) 28 July 1998 (28.07.98)	
Applicant GOATLEY, Ernest, Paul			

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

AP : GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE

National : AU, BG, BR, CA, CN, CZ, DE, IL, JP, KP, KR, MN, NO, PL, RO, RU, SE, SK, US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

National : AE, AL, AM, AT, AZ, BA, BB, BY, CH, CU, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU,
ID, IN, IS, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MW, MX, PT, SD, SG, SI, SL, TJ,
TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer: J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38



European Patent
Office

SUPPLEMENTARY
EUROPEAN SEARCH REPORT

Application Number
EP 99 93 1638

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 480 014 A (BRACE CHRISTIAN J ET AL) 2 January 1996 (1996-01-02) * column 1, line 59 - line 67; figures * ---	1-5,7-9, 11-14	F16H61/30 F16H61/28 F16H63/30
X	DE 19 13 064 A (KLAUE HERMANN) 24 September 1970 (1970-09-24) * figure 3 * ---	1-9	
X	DE 38 38 708 A (STEYR DAIMLER PUCH AG) 6 July 1989 (1989-07-06) * the whole document * ---	1-5,7-9	
X	US 3 059 743 A (MCNAMARA THOMAS V) 23 October 1962 (1962-10-23) * column 7, line 44 - line 51 * -----	1,9,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F16H F16D
The supplementary search report has been based on the last set of claims valid and available at the start of the search.			
Place of search MUNICH		Date of completion of the search 31 March 2003	Examiner Foulger, M
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure I ² : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rule 59.3(e) and 61.1(b), first sentence
and Administrative Instructions, Section 601(a))

To: Agent :

P L BERRY & ASSOCIATES
PO Box 1250
CHRISTCHURCH
New Zealand

Date of mailing (day/month/year)	2 DEC 1999 (2/12/99)
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Applicant's or agent's file reference 10571	IMPORTANT NOTIFICATION
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International application No. PCT/NZ99/00114	International filing date (day/month/year) 26 JUL 1999 (26/7/99)	Priority date (day/month/year) 28 JUL 1998 (28/7/98)
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Applicant

Goatley; Ernest Paul

1. The applicant is hereby **notified** that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

29 NOV 1999 (29/11/99)

2. That date of receipt is:

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- ☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- ☐ the date on which this Authority has, in response to the Invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. ☐ **Attention:** That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the elections(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide, Volume II*.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Facsimile No. 02 6285 3929	Authorized officer (Mrs) Cecilia TRACEY (02) 6283 2511 Telephone No.
--	---

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing: 10 February 2000 (10.02.00)	
International application No.: PCT/NZ99/00114	Applicant's or agent's file reference: 10571
International filing date: 26 July 1999 (26.07.99)	Priority date: 28 July 1998 (28.07.98)
Applicant: GOATLEY, Ernest, Paul	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International preliminary Examining Authority on:
29 November 1999 (29.11.99)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer: J. Zahra Telephone No.: (41-22) 338.83.38
---	---

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

P L BERRY & ASSOCIATES,
PO Box 1250
CHRISTCHURCH,
New Zealand

PCT**NOTIFICATION OF TRANSMITTAL OF
INTERNATIONAL PRELIMINARY EXAMINATION
REPORT**

(PCT Rule 71.1)

Date of mailing
day/month/year

13 JAN 2000

Applicant's or agent's file reference

10571

IMPORTANT NOTIFICATION

International application No.

PCT/NZ 99/00114

International filing date

26 July 1999

Priority date

28 July 1998

Applicant

GOATLEY; Ernest Paul

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translations to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide

Name and mailing address of the IPEA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaaustralia.gov.au
Facsimile No. (02) 6285 3929

Authorized officer

KURT TOBLER

Telephone No. (02) 6283 2469

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 10571	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. PCT/NZ 99/00114	International filing date (<i>day/month/year</i>) 26 July 1999	Priority Date (<i>day/month/year</i>) 28 July 1998
International Patent Classification (IPC) or national classification and IPC Int. Cl.⁶ F16H 61/30, 61/28		
Applicant GOATLEY; Ernest Paul		

1.	This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.																								
2.	This REPORT consists of a total of 3 sheets, including this cover sheet. <input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of 2 sheet(s).																								
3.	This report contains indications relating to the following items: <table style="width: 100%; border: none;"> <tr> <td style="width: 5%;">I</td> <td style="width: 5%;"><input checked="" type="checkbox"/></td> <td style="width: 90%;">Basis of the report</td> </tr> <tr> <td>II</td> <td><input type="checkbox"/></td> <td>Priority</td> </tr> <tr> <td>III</td> <td><input type="checkbox"/></td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td>IV</td> <td><input type="checkbox"/></td> <td>Lack of unity of invention</td> </tr> <tr> <td>V</td> <td><input checked="" type="checkbox"/></td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td>VI</td> <td><input type="checkbox"/></td> <td>Certain documents cited</td> </tr> <tr> <td>VII</td> <td><input type="checkbox"/></td> <td>Certain defects in the international application</td> </tr> <tr> <td>VIII</td> <td><input type="checkbox"/></td> <td>Certain observations on the international application</td> </tr> </table>	I	<input checked="" type="checkbox"/>	Basis of the report	II	<input type="checkbox"/>	Priority	III	<input type="checkbox"/>	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	IV	<input type="checkbox"/>	Lack of unity of invention	V	<input checked="" type="checkbox"/>	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	VI	<input type="checkbox"/>	Certain documents cited	VII	<input type="checkbox"/>	Certain defects in the international application	VIII	<input type="checkbox"/>	Certain observations on the international application
I	<input checked="" type="checkbox"/>	Basis of the report																							
II	<input type="checkbox"/>	Priority																							
III	<input type="checkbox"/>	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability																							
IV	<input type="checkbox"/>	Lack of unity of invention																							
V	<input checked="" type="checkbox"/>	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement																							
VI	<input type="checkbox"/>	Certain documents cited																							
VII	<input type="checkbox"/>	Certain defects in the international application																							
VIII	<input type="checkbox"/>	Certain observations on the international application																							

Date of submission of the demand 29 November 1999	Date of completion of the report 23 December 1999
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer KURT TOBLER Telephone No. (02) 6283 2469

Basis of the report

1. With regard to the **elements** of the international application:*
- ☐ the international application as originally filed.
- ☒ the description, pages 3-6, as originally filed,
pages 1-2, filed with the demand,
pages , filed with the letter of .
- ☒ the claims, pages 7-9, as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages , filed with the letter of .
- ☒ the drawings, pages 1-2, as originally filed,
pages , filed with the demand,
pages , filed with the letter of .
- ☐ the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , filed with the letter of .
2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:
- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:
- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished
4. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/fig.
5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1-14	YES
	Claims	NO
Inventive step (IS)	Claims 1-14	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-14	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

All the documents cited in the ISR were category A only. Therefore the claimed invention is not disclosed in any of these patent documents and hence all the claims are novel.

The claimed invention is not obvious in the light of any of the cited documents nor disclosed in any obvious combination, nor would the claimed invention be obvious to a person skilled in the art in the light of common general knowledge by itself or in combination with any of these documents.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 99/00114

A. CLASSIFICATION OF SUBJECT MATTERInt Cl⁶: F16H 61/30, 61/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
F16H 61/30, 61/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4843902 A (PATTON et al.) 4 July 1989 Whole document	
A	JP 09-112636 A (ISEKI AGRIC MACH MFG CO LTD) 2 May 1997 Abstract and drawings	

☐ Further documents are listed in the continuation of Box C

☐ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
30 September 1999

Date of mailing of the international search report

- 8 OCT 1999

Name and mailing address of the ISA/AU
AUSTRALIAN PATENT OFFICE
PO BOX 200
WODEN ACT 2606
AUSTRALIA
Facsimile No.: (02) 6285 3929

Authorized officer

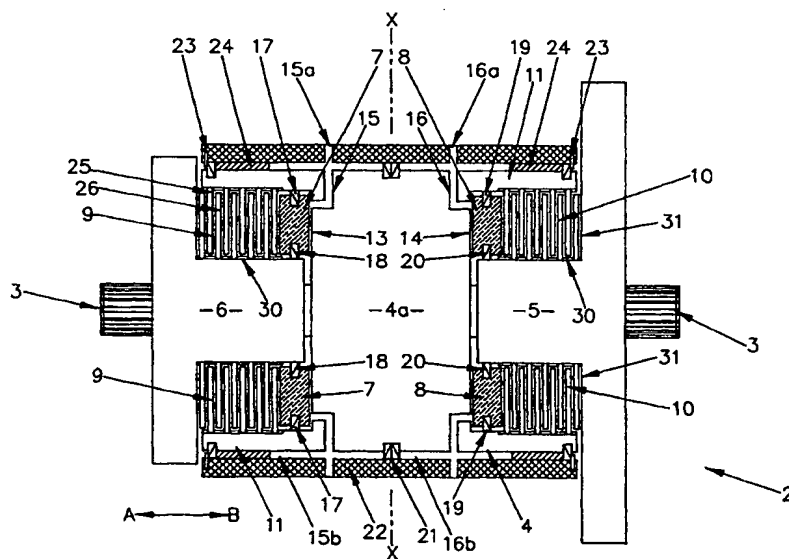
KURT TOBLER

Telephone No.: (02) 6283 2469



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : F16H 61/30, 61/28	A1	(11) International Publication Number: WO 00/06927 (43) International Publication Date: 10 February 2000 (10.02.00)
(21) International Application Number: PCT/NZ99/00114 (22) International Filing Date: 26 July 1999 (26.07.99) (30) Priority Data: 331192 28 July 1998 (28.07.98) NZ (71)(72) Applicant and Inventor: GOATLEY, Ernest, Paul [NZ/NZ]; 166 Clyde Street, Balclutha (NZ). (74) Agent: BUCHANAN, Elspeth, Victoria; P.L. Berry & Associates, P.O. Box 1250, Christchurch (NZ).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>

(54) Title: GEARBOX ADAPTOR**(57) Abstract**

A gearbox adaptor (2) which can be combined with a standard vehicle gearbox to convert a standard gearbox to a sequential gearbox. Some or all of the gears (5, 6) of a standard gearbox have the synchro-hubs and cones removed and one or more gearbox adaptors (2) substituted. Each adaptor (2) includes a hub (4) which engages the gear shaft (3), at least one piston (7, 8) mounted within the hub (4), means for supplying fluid (16) from the exterior of the hub (4) to a first face of the or each piston (7, 8), at least one clutch means (9, 10), part of which engages the hub and another part of which engages a gear (5, 6) located on the gear shaft (3); the arrangement being such that movement of the piston (7, 8) in a predetermined first direction inter-engages the parts of the clutch (9, 10) to drivingly engage the gear (5, 6) and the gear shaft (3).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
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Title: GEARBOX ADAPTORTechnical Field

The present invention relates to a gearbox adaptor for insertion into a standard gearbox to convert a standard gearbox to a sequential gearbox. As used herein, the term 'standard gearbox' means a gearbox in which, to change from one gear to another, the gear-lever must be moved in a direction which depends upon which gear is being moved out of and which gear is being moved into. The term 'sequential gearbox' means a in which to change up a gear, the gear-lever always is moved in one direction, and to change down a gear, the gear-lever always is moved in the opposite direction.

Sequential gearboxes are especially useful in racing and rally cars, where rapid gear changes without looking at the gear-lever are essential.

Background Art

Purpose-built sequential gear boxes are known, but are much more expensive than standard gearboxes. Further, known sequential gearboxes provide a comparatively slow gear-change:- the engine must be unloaded to change gear, and the car therefore decelerates for the period of the gear change, (typically about 0.1 sec.), resulting in a loss of speed of the order of 3.5 kph.

It is therefore an object of the present invention to provide a gearbox adaptor which is capable of insertion into a standard gearbox to convert it to a sequential gearbox, the combination of providing a sequential gearbox in which gear changes can be made rapidly (typically 0.02 sec.) and at full throttle, so that the car does not lose speed during a gear change.

Disclosure of Invention

The present invention provides a gearbox adaptor including: a hub adapted to be engageable with a gear shaft for rotation therewith; at least one piston mounted within said hub; means for supplying fluid from the exterior of the hub to a first face of the or each said piston, so as to move said piston in a first direction; at least one clutch means adjacent the or each said piston, part of the or each said clutch means being engaged with said hub and a different part of the or each said clutch means being engageable with a gear locatable on said gear shaft adjacent said hub; the or

each said clutch means being located and arranged such that movement of said piston in said first direction inter-engages said parts of said clutch to drivingly engage said gear and said gear shaft.

5 Preferably, the piston and clutch means both are annular and are concentric with each other and with the hub. Preferably, the hub is concentrically engageable with the gear shaft.

10 Preferably the adaptor further comprises a casing surrounding at least part of the exterior of said hub, said casing being mounted upon said hub but not rotatable therewith; at least one first fluid passage being formed between the interior of the casing and the exterior of the hub, the or each said first fluid passage being in communication with said means for supplying fluid to a first face of the or each said piston, which comprises at least one second fluid passage formed through said hub.

15 It is known to provide a hydraulically operated piston, clutch, and hub system for a gearbox, but known systems supply hydraulic fluid through the gear shaft. This arrangement cannot be used to adapt existing gearboxes, since in existing standard gearboxes, the shafts are not provided with hydraulic passages.

20 The present invention further provides a sequential gearbox as defined above which includes a standard gearbox from which the synchro-hubs and cones have been removed and a gearbox adaptor in accordance with the present invention has been fitted to each gear. It is possible to use an adaptor of the present invention to adapt each gear individually, but preferably the double adaptor of the present invention is used, with each double adaptor being fitted between each pair of adjacent gears in the standard gearbox.

25 Preferably, all of the gears of a standard gearbox are adapted to the present system, but it is also possible to adapt only some of the gears of a standard gearbox, and leave the remaining gear or gears to be operated in known manner.

30 The sequential gearbox described above preferably includes electronic control means which comprises two micro switches which are connected via a sequencing arrangement to a set of solenoid valves, one solenoid valve being connected to the means for supplying fluid to each piston such that fluid is supplied to said piston when said solenoid valve is open and fluid is withdrawn from said piston when said solenoid valve is closed; the control means being such that each time the first micro switch is closed, the sequencing arrangement closes any solenoid valve which is

open and opens the next solenoid valve in a predetermined first sequence, and each time the second micro switch is closed, the sequencing arrangement closes any solenoid valve which is open and opens the next solenoid valve in a predetermined second sequence.

- 5 Preferably, the or each clutch means comprises a clutch pack which consists of a first series of spaced plates each of which is engageable with the hub for rotation therewith but which is reciprocable parallel to the longitudinal axis of said hub; and a second series of spaced plates each of which is engageable with a gear mounted upon said gear shaft but which is reciprocable parallel to the longitudinal axis of said
10 hub; said second series of plates being interleaved with the plates of said first series.

Brief Description of Drawings

By way of example only, a preferred embodiment of the present invention is described in detail, with reference to the accompanying drawings, in which:-

- Fig. 1 is a schematic sectional view through part of a gearbox adaptor in accordance
15 with the present invention, the adaptor being for a pair of gears;

Fig. 2a and 2b are plan views of two clutch components; and

Fig. 3 is a block diagram showing the electronic controls.

Best Mode of Carrying Out the Invention

- Referring to Figs. 1 and 2 of the drawings, a gearbox adaptor 2 comprises a central
20 splined shaft 3 upon which are mounted a hub 4, a first gear 5, a second gear 6, two pistons 7, 8 and two clutch packs 9, 10.

The shaft 3 is the main shaft of a standard gearbox and is externally splined, and driven in known manner. The hub 4 is internally splined and the hub splines engage the splines of the shaft 3 so that the hub 4 rotates with the shaft 3.

- 25 The first and second gears 5, 6 are gears of known type, forming part of a standard gearbox and are freely rotatable relative to the shaft 3, but are fixed in position relative to the length of the shaft 3.

- The hub 4 has a central portion 4a concentric with the shaft 3, with a rim 11 around the periphery of said central portion. The rim 11 is of greater width than the central
30 portion 4a.

The extension of the rim beyond the central portion of the hub provides two annular recesses in which the pistons 7, 8 and the clutch packs 9, 10 are mounted, concentric with the shaft 3.

Each piston 7, 8, is annular and is mounted adjacent one side of the central portion 4a of the hub, spaced from the hub by a passage 13, 14 respectively. The passages 13, 14 are connected to corresponding passages 15, 16 in the hub 4, through which hydraulic fluid can be supplied to the passages 13, 14, as hereinafter described.

Pairs of annular seals 17, 18, 19, 20 respectively, seal the gaps between the edges of the pistons 7, 8 and the adjacent walls of the gears and the hub respectively.

A further annular seal 21 (e.g. a cast-iron seal ring) extends around the outer wall of the rim between the passages 15 and 16. The seal 21 extends between the outer wall of the rim and a casing 22 which surrounds the hub 4 and is located on the hub by circlips 23. Bushes 24 may be located between the opposed faces of the hub 4 and casing 22, to permit the casing 22 to remain stationary while the hub 4 rotates. Alternatively, the bushes 24 may be omitted since the combination of the seal 21 and the layer of hydraulic fluid in the passages 15b, 16b between the outer wall of the rim and the inner wall of the casing 22 effectively acts as a bearing in practice.

Fluid passages 15a, 16a, corresponding to passages 15 and 16 are formed in the casing 22, for supply of hydraulic fluid.

Each clutch pack 9, 10 comprises a series of annular steel plates 25 interleaved alternately with a series of annular bronze plates 26. Each steel plate 25 is formed with four equidistantly-spaced dogs 27 (Fig. 2a only) which are dimensioned and arranged to engage corresponding grooves (not shown) in the adjacent face of the rim 11, so that the steel plates rotate with the hub but can move relative to the hub in the directions indicated by arrows A and B.

Alternatively, the steel plates 25 may be formed with external splines instead of the dogs 27, said splines engaging corresponding splines formed in the rim 11.

Each bronze plate 26 is formed with splines 28 around its inner periphery. The splines 28 are received in corresponding grooves (not shown) on the adjacent portions 30 of the gears 5, 6, so that the bronze plates 26 rotate with the gears 5, 6, but can move relative to the gears in the directions of arrows A and B.

It will be appreciated that the bronze plates 26 could be formed with dogs rather than splines. Further, the materials of which the clutch pack plates are made can be varied:- any suitable materials having acceptable wear characteristics and providing a good frictional grip, may be used (e.g. carbon fibre, sintered bronze).

- 5 To convert the whole of a standard gearbox using the present invention, all of the synchro-hubs and cones are removed from the standard box, and a gearbox adaptor as described above is fitted between each pair of gears: first/second and third/fourth. For reverse gear, the standard clutch system may be retained, or a single gear adaptor as hereinafter described, can be used. If the standard gearbox has an odd
10 number of forward gears, then either the standard clutch system is used for the 'odd' gear or a single gear adaptor can be used.

To modify the above-described adaptor for a single gear, the hub shown in Fig. 1 is effectively split in two, by terminating the hub on a line X-X in Fig. 1, with a blank wall. This gives a single gear adaptor. It is possible to use a single-gear adaptor for
15 each gear in a multi-gear box, but it is preferred to use two-gear adaptors as shown in Fig. 1, since this gives a more compact construction.

It also is possible to construct an adaptor as a single unit for three or more gears, by extending the design of Fig. 1. Further, although the invention is described as an adaptor for an existing gearbox, it will be appreciated that it is possible to build a
20 gearbox 'from scratch' incorporating the adaptor of the present invention.

The above-described system can be controlled by any suitable control, but preferably is controlled by an electronic/hydraulic system as shown in Fig. 3.

The control system includes an electronic joystick (not shown) which is connected to a first and a second micro-switch 32, 33 such that when the joystick is moved in one
25 direction, the first micro-switch 32 is closed, and when the joystick is moved in the opposite direction, the second micro-switch 33 is closed. The micro-switches 32, 33 are connected to a series of solenoid valves 50,60,70,80, each controlling the flow of hydraulic fluid to one section of one of the hubs 4, via a series of relays 51,61,71,81 and a sequencing arrangement (e.g. a control integrated circuit) which provide that
30 each time the first micro-switch 32 is closed, the next solenoid in the sequence 50,60,70,80 is opened and each time the second micro-switch 33 is closed, the next solenoid in the sequence 80,70,60,50 is opened.

When the first solenoid valve is opened, hydraulic fluid is supplied through that valve to one of the passages 16a and hence to the associated passages 16 and 14, to push the piston 8 in the direction of arrow B. The piston 8 contacts the plates of the clutch pack 10 and pushes them in the same direction, urging the plates of the clutch pack into contact with each other and with the face 31 of the first gear. Since the plates 25 of the clutch pack are splined to the hub 4 and the plates 26 to the gear 5, and the hub 4 is splined to the shaft 3, pushing the plates 25, 26 together into driving contact with each other brings the first gear 5 into driving engagement with the shaft 3, and the gear rotates with the shaft, so that the vehicle drives in first gear. When the second solenoid valve is opened, the electronic control circuit closes the first solenoid. When the first solenoid valve is closed, the rotation of the gearbox tends to fling fluid out of the passages 14/16/16a, drawing the piston 8 back to the position of Fig. 1 and disengaging first gear.

When the second solenoid valve is opened, fluid is supplied to passages 15a/15 and 13 and the second gear is engaged in the same manner as the first.

Thus, every time the joystick is moved in said one direction, the solenoid valve (if any) which is open, is closed, and the next solenoid valve in the sequence 50,60,70,80 is opened, to engage the next higher gear. Every time the joystick is moved in the opposite direction, the solenoid valve which was open is closed, and next solenoid valve in the sequence 80,70,60,50 is opened to engage the next lower gear.

It is envisaged that the solenoid valves could be controlled automatically by a rev-counter, so that the gears are changed up or down automatically, depending upon the engine revs.

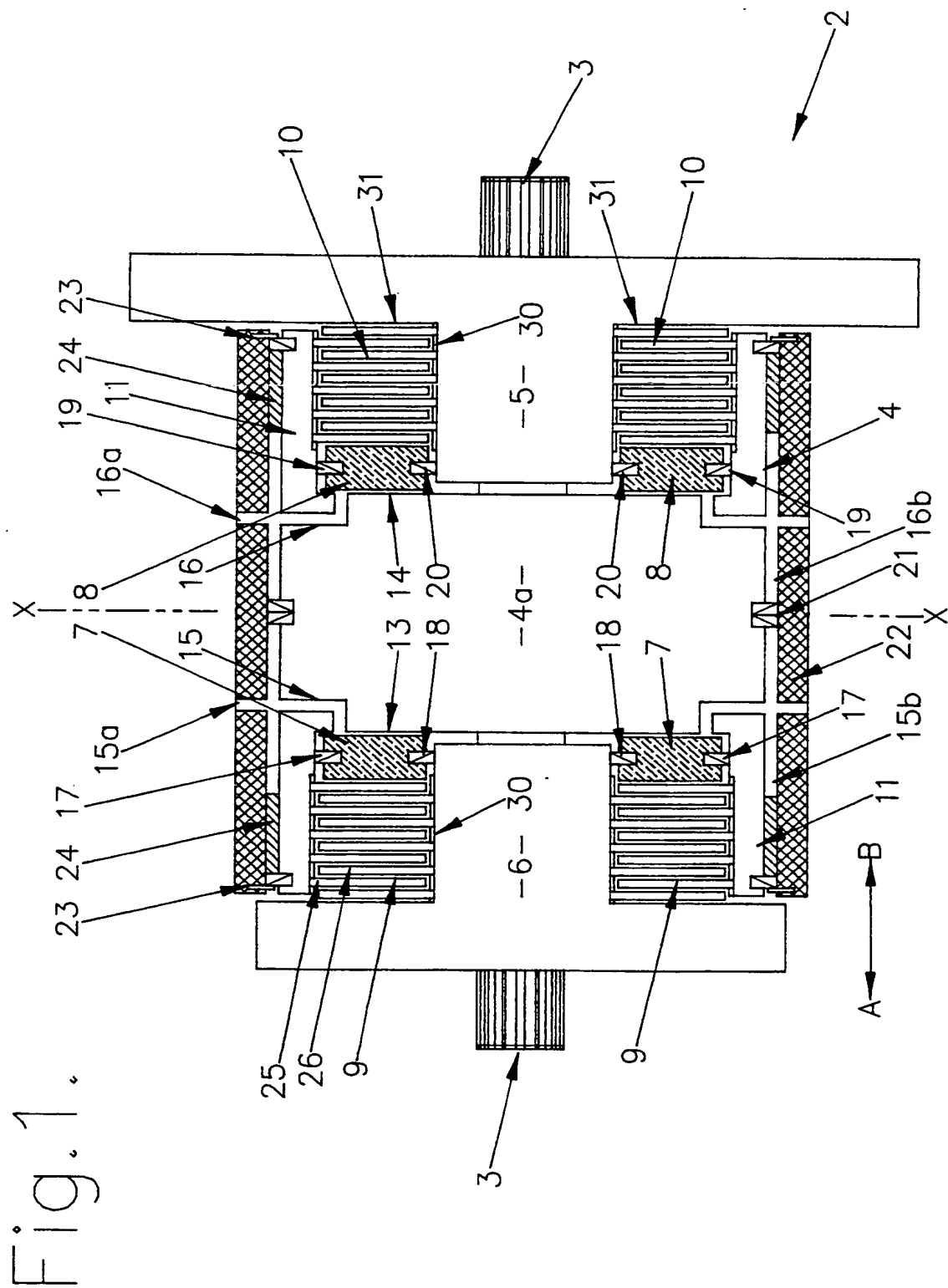
Claims

1. A gear box adaptor including: a hub adapted to be engageable with a gear shaft for rotation therewith; at least one piston mounted within said hub; means for supplying fluid from the exterior of the hub to a first face of the or each said piston, so as to move said piston in a first direction; at least one clutch means adjacent the or each said piston, part of the or each said clutch means being engaged with said hub and a different part of the or each said clutch means being engageable with a gear locatable on said gear shaft adjacent said hub; the or each said clutch means being located and arranged such that movement of said piston in said first direction inter-engages said parts of said clutch to drivingly engage said gear and said gear shaft.
2. The adaptor as claimed in claim 1 wherein said hub, the or each said piston and the or each said clutch means all are concentric and said hub is adapted to be concentrically engageable with said gear shaft.
3. The adaptor as claimed in claim 2 wherein the or each said piston and the or each said clutch means both are annular.
4. The adaptor as claimed in claim 2 or claim 3 wherein the or each said clutch means comprises a clutch pack which consists of a first series of spaced plates each of which is engaged with the hub for rotation therewith but which is reciprocable parallel to the longitudinal axis of said hub; and a second series of spaced plates each of which is engageable with a gear mounted upon said gear shaft but which is reciprocable parallel to the longitudinal axis of said hub; said second series of plates being interleaved with the plates of said first series.
5. The adaptor as claimed in any one claims 2-4 wherein the or each said clutch means and the or each said piston are mounted in a recess in said hub.
6. The adaptor as claimed in claim 5 further comprising a casing surrounding at least part of the exterior of said hub, said casing being mounted upon said hub but not rotatable therewith; at least one first fluid passage being formed between the interior of the casing and the exterior of the hub, the or each said first fluid passage being in communication with said means for supplying fluid to a first face of the or each said piston, which comprises at least one second fluid passage formed through said hub.

7. The adaptor as claimed in any one of claims 1-4 incorporating two said pistons and two said clutch means, the first piston and the corresponding first clutch means being mounted in a first recess formed in one end of the hub, and the second piston and the corresponding second clutch means being mounted in a second recess formed in the other end of the hub; wherein part of the first clutch means is engageable with a first gear and part of the second clutch means is engageable with a second gear.
8. The adaptor as claimed in claim 7 further comprising a casing surrounding at least part of the exterior of said hub, said casing being mounted upon said hub but not rotatable therewith; two separate first fluid passages being formed between the interior of the casing and the exterior of the hub, each said first fluid passage being in communication with the corresponding said means for supplying fluid to a first face of said corresponding piston, which comprises a second fluid passage formed through said hub.
9. The adaptor as claimed in any one of the preceding claims wherein said fluid is hydraulic fluid.
10. The adaptor as claimed in any one of the preceding claims where said fluid is pneumatic fluid.
11. A sequential gearbox as hereinbefore defined, including a standard gearbox from which the synchro-hubs and cones have been removed and a gearbox adaptor as claimed in any one of claims 1-6 has been fitted to each gear, with part of each hub mounted on the gear shaft and each clutch means engaged with the corresponding gear.
12. A sequential gearbox as hereinbefore defined, including a standard gearbox from which the synchro-hubs and cones have been removed and a gearbox adaptor as claimed in claim 7 or claim 8 has been fitted between each pair of adjacent gears, with each hub mounted on the gear shaft between said two adjacent gears and part of one clutch means engaged with one of said gears and part of the other clutch means engaged with the other of said gears.
13. A sequential gearbox as claimed in claim 11 or claim 12, further including electronic control means which comprises two micro-switches which are connected via a sequencing arrangement to a set of solenoid valves, one solenoid valve being connected to the means for supplying fluid to each piston

such that fluid is supplied to said piston when said solenoid valve is open and fluid is withdrawn from said piston when said solenoid valve is closed; the control means being such that each time the first micro-switch is closed, the sequencing arrangement closes any solenoid valve which is open and opens the next solenoid valve in a predetermined first sequence; and each time the second micro-switch is closed, the sequencing arrangement closes any solenoid valve which is open and opens the next solenoid valve in a predetermined second sequence.

14. The sequential gearbox as claimed in claim 13, wherein said predetermined second sequence is the reverse of said predetermined first sequence.



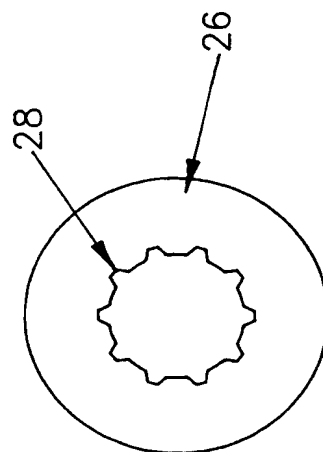
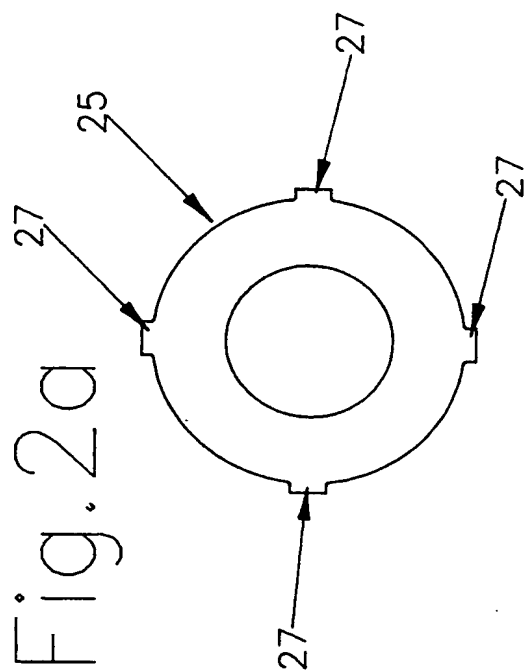


Fig. 2b

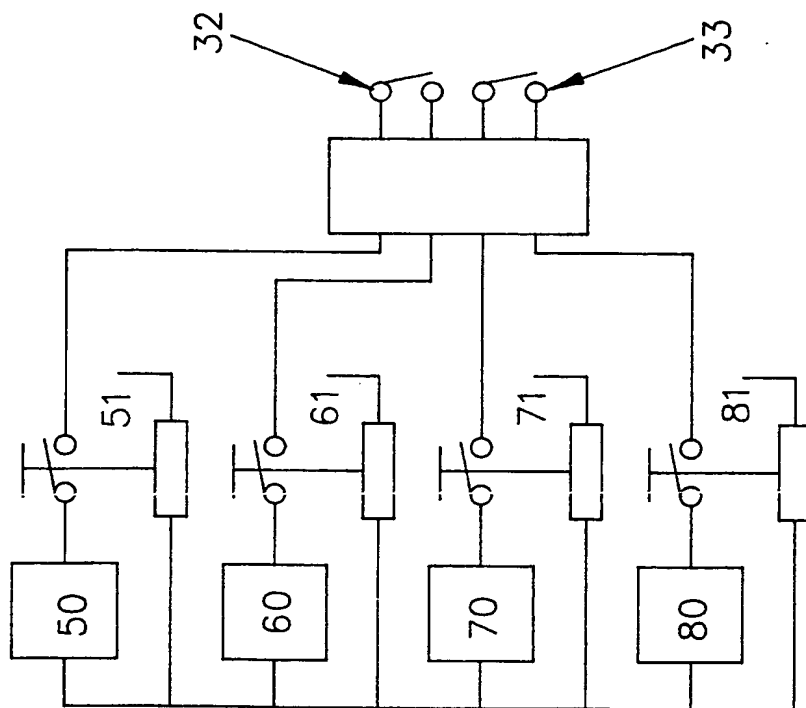


Fig. 3.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 99/00114

A. CLASSIFICATION OF SUBJECT MATTERInt Cl⁶: F16H 61/30, 61/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
F16H 61/30, 61/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4843902 A (PATTON et al.) 4 July 1989 Whole document	
A	JP 09-112636 A (ISEKI AGRIC MACH MFG CO LTD) 2 May 1997 Abstract and drawings	

☐ Further documents are listed in the continuation of Box C☐ See patent family annex

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Date of the actual completion of the international search

30 September 1999

Date of mailing of the international search report

- 8 OCT 1999

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the gearbox of run vehicles, such as a tractor.

[0002]

[Description of the Prior Art] While the gearbox of a tractor consists of the pre-go-astern gear change section, the main gear change section, and the subgear change section and changing advance and go-astern in the pre-go-astern gear change section, much gear change positions of the stage (for example, 16 steps) are set up in the combination of the main gear change by the main gear change section, and the subgear change by the subgear change section. In the conventional tractor, there were what constituted each [these] gear change section from a synchromesh mechanism, and a thing constituted from a hydraulic-clutch mechanism.

[0003] It is easy structure compared with the composition by the hydraulic-clutch mechanism, while the composition by the synchromesh mechanism has the advantage that cost is cheap, in order to align rotation of the side transmitted [transmission and] smoothly, the clutch which severs transmission is required for it at a transmission superior [of the gear change section], or lower-part side, and since the operation process at the time of a shift change increases by moreover preparing a clutch, the difficulty that a quick shift change cannot carry out is.

[0004] On the other hand, the composition by the hydraulic-clutch mechanism can perform a shift change quickly and smoothly, without preparing a clutch independently, since ON-OFF [transmission from a transmission side to a transmitted side] in an instant. However, since the composition by the hydraulic-clutch mechanism must prepare the oilway which sends a hydraulic oil in a transmission shaft, its structure is complicated, and when arranging each gear change section side by side forward and backward, it has the problem that the whole gearbox order length becomes long. Furthermore, when all the gear change sections are made into a hydraulic-clutch mechanism, it is also a big problem that cost costs dearly.

[0005] Then, the proposal made in the composition which does not independently prepare the clutch for a shift change is made by combining the gear change section by the synchromesh mechanism, and the gear change section by the hydraulic-clutch mechanism, and carrying out the shift change of the gear change section by the synchromesh mechanism, where the gear change section by the hydraulic-clutch mechanism is cut (JP,61-58691,B, JP,6-2038,Y).

[0006]

[The technical problem which is going to solve invention] However, since change operation of two or more gear change sections had to be carried out when changing a gear change position, when it was the composition which combined the gear change section by the synchromesh mechanism, and the gear change section by the hydraulic-clutch mechanism like the above and the timing of the change operation was out of order, a shift change was not performed smoothly but the shock might arise.

[0007] Moreover, since the multi-board type hydraulic clutches 29, 30, 31, and 32 were formed in the clutch support shafts 17 and 18 arranged on the outside of a driving shaft 16 and a driven shaft 9, the transmission structure currently indicated by JP,61-58691,B had the problem that it was bulky in a cross direction and the direction which goes direct.

[0008] In view of the above-mentioned situation, this invention realizes automatic transmission-ization, in order to enable quick shift change operation, and it makes it a technical problem to offer a low cost and a compact gearbox comparatively so that it may moreover be suitable also for a minor type tractor.

[0009]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention was constituted as follows. Namely, the gearbox concerning this invention arranges the gear change section by the hydraulic-clutch mechanism in a transmission superior [of the gear change section by the synchromesh mechanism], and lower part side, respectively. By being characterized by considering each gear change section as the composition which carries out a shift change with the actuator by electromagnetic control, and carrying out the shift change of the gear change section by the aforementioned synchromesh mechanism, where the gear change section by the aforementioned hydraulic-clutch mechanism is cut It is considering as the composition which does not independently prepare the clutch for a shift change.

[0010] Moreover, the gearbox concerning this invention establishes the first gear change shaft on the extension wire of a driving shaft, and while it prepares close and two hydraulic clutches which carry out OFF in the first gear change shaft, on it the rotational-motion force from the aforementioned driving shaft to the first gear change shaft concerned Prepare the second gear change shaft in the aforementioned first gear change shaft and parallel, and close and two hydraulic clutches which carry out OFF are prepared for the rotational-motion force from the aforementioned driving shaft to the second gear change shaft concerned in

the second gear change shaft. It is characterized by having the gear change section which approached in the direction which intersects shaft orientations and has arranged the hydraulic clutch by the side of the first gear change shaft, and the hydraulic clutch of the second gear change shaft.

[0011]

[Embodiments of the Invention] Hereafter, one example of the tractor which formed the gearbox of this invention is explained.

[0012] The tractors 1 shown in drawing 1 are order four-wheel-drive vehicles, and equip the four-corners section of an airframe with front wheels 2 and 2 and rear wheels 3 and 3. The front axle case 5 which supports the axle of front wheels 2 and 2 is attached in the front frame 7 bottom, and the rear axle cases 6 and 6 which support rear wheels 3 and 3 are attached in the rear side of the missions case 8. The front axle case 5 is fixed to revolve with the longitudinal-direction center section free right-and-left rocking] at the circumference of the axial center suitable for the cross direction of fixation on the front frame 7, and front wheels 2 and 2 move up and down with the irregularity of the ground.

[0013] The engine 10 is carried in the center bottom of the front frame 7 free [attachment and detachment]. As for a radiator and 12, 11 is [a cooling fan and 13] fan belts, and these are arranged ahead of the engine 10. 14 is a bonnet and has covered the front and the side of an engine 10 or **** (illustration abbreviation).

[0014] 16 is a handle, and if right-and-left rotation of this handle is carried out, front wheels 2 and 2 will carry out guide rocking of it at right and left. Moreover, 17 is a gearshift lever and carries out gear change operation by this. It applies to the upper part from the front of the rear wheels 3 and 3 on either side, fenders 21 and 21 are attached, and the seat 22 is formed among these right-and-left fenders 21 and 21. The operator step section of the lower part of a seat 22 serves as the abbreviation plate-like floor 23.

[0015] The lift arms 27 and 27 which carry out vertical rotation with the rise-and-fall oil hydraulic cylinder 26 are formed in the rear of an airframe. The point of these lift arms 27 and 27 and the pars intermedia of the lower links 27a and 27a for work machine wearing are connected by lift rods 27b and 27b, and work machines, such as a rotary tiller with which the back end section of lower links 27a and 27a was equipped, go up and down by raising the lift arms 27 and 27, and operating and lowering operating. Moreover, one of the two's lift-rod 27b (the example of illustration right-hand side) is an oil hydraulic cylinder for right-and-left tilting, and the cant of a work machine is adjusted by making this oil hydraulic cylinder expand and contract. In addition, top link 27d is attached in the upper part of lower links 27a and 27a, and a right-and-left center section, and a work machine is supported by the tripartite link mechanism which consists of lower links 27a and 27a and top link 27d.

[0016] Drawing 2 is the transmission organization chart of this tractor, and a cross section with which drawing 3 - drawing 5 express structure for the important section. First, the outline of a driving mechanism is explained.

[0017] The rotational-motion force of an engine 10 is inputted into the missions case 8. A main clutch 30 is formed in the entrance section of the missions case 8, it has entered and transmission is carried out. Transmission branching of the power which passed through the main clutch 30 is carried out at two lines, the run driving force which drives a front wheel and a rear wheel, and the PTO driving force of external power extraction. Run driving force is transmitted by rear wheel differential-gear equipment 34 through the run gearbox which consists of the pre-go-astern gear change section 31, the main gear change section 32, and the subgear change section 33, and drives the rear wheels 3 and 3 on either side. Moreover, with a run gearbox, via the 4WD transfer device 35, the power after gear change is taken out by the front section of the missions case 8, and is transmitted by front-wheel transmission shaft 5a by the front-wheel differential-gear equipment 36 within the front axle case 5, and drives the front wheels 2 and 2 on either side. On the other hand, PTO driving force is taken out from the tooth-back section of the missions case 8 via the PTO positive reversing device 37 and the PTO gearbox 38 by the PTO shaft 39 which projects in back. The transmission shaft to various work machines (illustration abbreviation) enables transmission connection of the attachment and detachment at the lobe of the PTO shaft 39.

[0018] Next, the structure of each gear change section of a run gearbox is explained. The pre-go-astern gear change section 31 is the gear change section which changes rotation of the main-clutch shaft S1 in normal rotation or the inversion direction alternatively, and transmits it to it at the pre-go-astern gear change shaft S3. The gear G1 attached in the back end section of the main-clutch shaft S1 geared on the gear G2 of the relay shaft S2, and the gear G2 has geared further to advance gear G3 which fits into the pre-go-astern gear change shaft S3 free [rotation] by needle bearing. Moreover, the gear G4 is attached in the relay shaft S2 apart from the aforementioned gear G2, and the gear G4 has geared through the counter gear G5 of the counter shaft S4 on the go-astern gear G6 which fits into the pre-go-astern gear change shaft S3 free [rotation] by needle bearing. Therefore, advance gear G3 and the go-astern gear G6 of each other are rotated to an opposite direction.

[0019] Advance gear G3 and the go-astern gear G6 are the advance clutch CF of wet multi-board hydraulic-clutch structure. Go-astern clutch CB Transmission connection is carried out at the pre-go-astern gear change shaft S3. Namely, it is attached so that the drive drum 41 may really rotate by the spline on the pre-go-astern gear change shaft S3. And the interior of the really fabricated go-astern clutch boss 42B is carried out to advance clutch boss 42F really fabricated by the inner circumference section of this drive drum at aforementioned advance gear G3, and the aforementioned go-astern gear G6. The file plate 44 by the side of advance and a go-astern clutch boss and -- are arranged in the parallel state by turns with the file plate 43 by the side of a drive drum, and -- moreover -- the both sides of bridge-wall 41a of the drive drum 41 -- the object for advance clutch ON OFF -- piston 45F and piston 45B for go-astern clutch ON OFF are arranged Suction pressurization of some lubricating oils with which it fills up in the missions case 8 is carried out with a hydraulic pump (not shown). the oilway which prepared it in the pre-go-astern gear change shaft S3 -- letting it pass -- bridge-wall 41a and the object for advance clutch ON OFF -- oil sac 46F between piston 45F -- or the thing to supply to either of the oil sac 46B between bridge-wall 41a and piston 45B for go-astern clutch ON OFF -- the object for advance clutch ON OFF -- piston 45F or piston 45B for go-astern clutch ON OFF is operated

These advance clutch CF And go-astern clutch CB Close and OFF control are carried out by the solenoid valve V1 (refer to drawing 6) for a pre-go-astern change.

[0020] the object for advance clutch ON OFF -- if piston 45F are operated and the file plate 44 by the side of advance clutch boss 42F and -- are made to stick by pressure with the file plate 43 by the side of the drive drum 41, and -- advance clutch CF It becomes close and the pre-go-astern gear change shaft S3 serves as the main-clutch shaft S1 and "advance" shift which rotates in this direction. Moreover, if piston 45B for go-astern clutch ON OFF is operated and the file plate 44 by the side of go-astern clutch boss 42B and -- are made to stick by pressure with the file plate 43 by the side of the drive drum 41, and --, it is the go-astern clutch CB. It becomes close and the order ** irregular shaft S3 serves as the main-clutch shaft S1 and a "go-astern" shift which rotates to an opposite direction. Which clutches CF and CB If it changes into the state of clutch OFF, it will become the "neutral" shift with which the transmission to future run drive systems is severed. Since sticking by pressure and estrangement of the file plate by the side of transmission and the file plate of a transmitted side are performed by oil pressure in an instant, the shift change of the main gear change section 31 is made quickly and smoothly.

[0021] In addition, the gear G2 of the relay shaft S2 has geared also with the inversion gear G8 into which the normal rotation gear G7 which fits into the periphery section of the right inversion gear change shaft S5 free [rotation] fits free [rotation in the periphery section of the right inversion gear change shaft S5] as for the counter gear G5 of engagement and the counter shaft S4, and PTO driving force is transmitted to the PTO positive reversing device 37. The hub 48 where the PTO positive reversing device 37 fits into these gears G7 and G8 and the right inversion gear change shaft S5 by the spline is constituted from a sleeve 49 which can slide on shaft orientations freely possible [transmission connection]. If transmission connection of the normal rotation gear G7 and the hub 48 is carried out, the right inversion gear change shaft S5 will rotate in the normal rotation direction. If transmission connection of the inversion gear G8 and the hub 48 is carried out, the right inversion gear change shaft S5 will rotate in the inversion direction, and if any of the normal rotation gear G7 and the inversion gear G8 do not carry out transmission connection of the hub 48, the right inversion gear change shaft S5 will carry out a rotation halt.

[0022] The main gear change section 32 is the gear change section which changes gears alternatively to the main gear change driven shaft S7 prepared in this and parallel, and is transmitted to four stages to it from the main gear change driving shaft S6 prepared so that it might the pre-go-astern gear change shaft S3 and really rotate. It is attached in one in the state that the 1st speed drive gear G9, the 2nd speed drive gear G10, the 3rd speed drive gear G11, and the 4th speed drive gear G12 make the main gear change driving shaft S6 fit in respectively free, and it is prepared, and the 1st speed follower gear G13, the 2nd speed drive gear G14, the 3rd speed follower gear G15, and the 4th speed follower gear G16 serve as a pair at the main gear change driven shaft S7 and of always gearing with the aforementioned drive The transmission ratio of these four pairs of main gear change gears is large in order of the 4th speed gear, the 3rd speed gear, the 3rd speed gear, and the 1st speed gear.

[0023] Transmission connection of each drive gears G9-G12 is carried out by the synchromesh mechanism at the main gear change driving shaft S6. That is, a hub 51 fits into the main gear change driving shaft S6 by the spline, a sleeve 52 fits into the periphery section of the hub 51 by the spline further, a key 53 gets into the slot formed in the sleeve 52, and rings 54 and 54 counter the cone sections 55 and 55 of the drive gears G9 and G10 (or G11, G12), and are prepared in the shaft-orientations both sides of the key 53. If a sleeve 52 is moved to one of shaft orientations by the shifter 56 which operates with the push pull oil hydraulic cylinders A and B (refer to drawing 6) formed in the exterior of the missions case 8, it will be pushed on a key 53, one of the two's ring 54 will contact the cone section 55 of a drive gear, rotation of a ring 54 will get across to the cone section 55 by friction, and the rotational speed of a drive gear and the main gear change driving shaft S6 will align. Furthermore, if a sleeve 52 is moved, the spline section of a sleeve 52 gears with the spline section of a drive gear, and the main gear change driving shaft S6 and a drive gear will be in the state where transmission connection was carried out completely. Push pull control of the aforementioned oil hydraulic cylinders A and B is carried out by the solenoid valves V2 and V3 (refer to drawing 6) for main gear change, respectively.

[0024] If transmission connection of the main gear change driving shaft S6 and the 1st speed drive gear G9 is carried out, it will become a "1st speed" shift. If transmission connection of the main gear change driving shaft S6 and the 2nd speed drive gear G10 is carried out, it will become a "2nd speed" shift. If transmission connection of the main gear change driving shaft S6 and the 3rd speed drive gear G11 is carried out, it will become a "3rd speed" shift. Moreover, if transmission connection of the main gear change driving shaft S6 and the 4th speed drive gear G12 is carried out, it will become a "4th speed" shift. Since it is necessary aligning smoothly rotation of the rotation gears G9, G10, G11, and G12 by the side of a hub 51, and to intercept the power from a transmission superior side or a lower part side, the pre-go-astern gear change section 31 or the subgear change section 33 is made "neutrality", and a shift change is carried out.

[0025] the subgear change section 33 -- rotation of the main gear change driven shaft S7 -- the first -- the [the subgear change shaft S8 and] -- it is the gear change section which changes gears alternatively and is transmitted to four stages to the 2 secondary gear change shaft S9 tubed part S7a of the main gear change driven shaft S7 and one are high-speed -- the gear G17 formed in clutch boss 62H -- the -- it has geared so that slowdown transmission may be carried out with the gear G18 formed in medium-speed clutch boss 62M which fit into the 2 secondary gear change shaft S9 free [rotation] Moreover, on the gear G22 formed in low-speed clutch boss 62L which fits in free [rotation on the subgear change shaft S8] for a start, another gear G21 which another gear G19 formed in high-speed clutch boss 62H geared so that slowdown transmission might be carried out with the gear G20 prepared in the relay shaft S10 at one, and was prepared in the relay shaft S10 at one has geared so that slowdown transmission may be carried out. furthermore, another gear G23 formed in low-speed clutch boss 62L -- the -- on the gear G24 formed in super-low-speed clutch boss 62LL which fits into the 2 secondary gear change shaft S9 free [rotation], it has geared so that slowdown transmission may be carried out Therefore, each clutch boss always rotates really and the rotational speed is large

in order of high-speed clutch boss 62H, medium-speed clutch boss 62M, and low-speed clutch boss 62L and super-low-speed clutch boss 62LL.

[0026] moreover, the gear G25 which fits into the subgear change shaft S8 by the spline for a start -- the -- it has geared on the gear G26 which fits into the 2 secondary gear change shaft S9 by the spline Furthermore, the gear G27 of one has geared with the gear G26 on the gear G28 of 4WD transfer device transmission shaft S11. In addition, the drive pinion G29 transmitted to rear wheel differential-gear equipment 34 is really formed in the back end section of the subgear change shaft S8 for a start.

[0027] high-speed -- clutch boss 62H and low-speed clutch boss 62L and the first -- the subgear change shaft S8 -- the subgear change clutch CH and CL transmission connection is carried out -- having -- the [medium-speed clutch boss 62M and super-low-speed clutch boss 62LL, and] -- transmission connection of the 2 secondary gear change shaft S9 is carried out with the sub***** clutches CM and CLL These secondary gear change clutch CH, CM, CL, and CLL are the aforementioned advance clutch CF. Go-astern clutch CB It is the same wet multi-board hydraulic-clutch mechanism, and close and OFF control are carried out, respectively by the solenoid valves V4, V5, V6, and V7 (refer to drawing 6) for subgear change. For 61, as for a file plate and 65, a drive drum, and 63 and 64 are [a piston and 66] oil sacs when only a sign name is described about a subgear change clutch.

[0028] some lubricating oils to which it fills up with the hydraulic oil which operates each ***** clutch CH, CM, CL, and CLL in the missions case 8 -- a hydraulic pump (not shown) -- suction pressurization -- carrying out -- it -- the first -- the [the subgear change shaft S8 or] -- it sends into an oil sac 66 and -- through the oilway prepared in the 2 secondary gear change shaft S9 Since it is impossible, it is the subgear change clutch CH and CL for a drive pinion G29 to really be formed in the back end section of the subgear change shaft S8 for a start, and for sheathing of the taper roller bearing to be further carried out to the anterior, and to take in a hydraulic oil from the back end side of the subgear change shaft S8 for a start. It is necessary to take in the hydraulic oil sent to oil sacs 66 and 66 from the front end side of the subgear change shaft S8 for a start. Then, a through-hole 67 and -- are prepared in tubed part S7a of the main gear change driven shaft S7, and it is considering as the composition of this through-hole 67 and -- which forms a circular sulcus 68 and -- in the periphery section of the subgear change shaft S8 for a start corresponding to a position, and is connected to the circular sulcus 68 and -- for a start with the oilway 69 within the subgear change shaft S8, and --. Since the hydraulic-oil introduction section is located in the missions case 8 order center section while composition becomes compact, since it is not necessary to prepare the portion for hydraulic-oil introduction in the subgear change shaft S8 specially for a start by considering as this oilway composition, piping which connects the hydraulic-oil introduction section to the oil pressure bulbs V4, V5, V6, and V7 prepared in the outside side of the missions case 8 can be shortened.

[0029] Subgear change clutch CH If it is close, while rotation of H is transmitted for a start to the subgear change shaft S8 and rotation of the subgear change shaft S8 is further transmitted from a drive pinion G29 for a start [the] to rear wheel differential-gear equipment 34, it will become the high-speed clutch boss 62 "high speed" shift transmitted to 4WD transfer device transmission shaft S11 through the combination of gears G25 and G26, and the combination of gears G27 and G28.

[0030] subgear change clutch CM It is transmitted to 2 secondary gear change shaft S9. if it is close -- rotation of medium-speed clutch boss 62M -- the -- the [furthermore, / the], while rotation of 2 secondary gear change shaft S9 is transmitted for a start by the combination of gears G26 and G25 to the subgear change shaft S8 and is transmitted from a drive pinion G29 to rear wheel differential-gear equipment 34 It becomes "medium-speed" shift transmitted by the combination of gears G27 and G28 to 4WD transfer device transmission shaft S11.

[0031] Subgear change clutch CL If it is close, while rotation of low-speed clutch boss 62L will be transmitted for a start to the subgear change shaft S8 and rotation of the subgear change shaft S8 will be further transmitted from a drive pinion G29 for a start [the] to rear wheel differential-gear equipment 34 It becomes the "low-speed" shift transmitted to 4WD transfer device transmission shaft S11 through the combination of gears G25 and G26, and the combination of gears G27 and G27.

[0032] It is transmitted to 2 secondary gear change shaft S9. if the subgear change clutch CLL is made close -- rotation of super-low-speed clutch boss 62LL -- the -- the [furthermore, / the], while rotation of 2 secondary gear change shaft S9 is transmitted for a start by the combination of gears G26 and G26 to the subgear change shaft S8 and is transmitted from a drive pinion G29 to rear wheel differential-gear equipment 34 It becomes the "super-low-speed" shift transmitted by the combination of gears G27 and G28 to 4WD transfer device transmission shaft S11.

[0033] If which subgear change clutch CH, CM, CL, and CLL are also changed into the state of clutch OFF, while severing the transmission to an order ring from the main gear change section 32, it becomes the "neutral" shift which intercepts that rotation by the inertia of an order ring gets across to the main gear change section 32. Since sticking by pressure and estrangement of the file plate by the side of transmission and the file plate of a transmitted side are performed by oil pressure in an instant, the shift change of the subgear change section 33 is made quickly and smoothly.

[0034] Thus, the subgear change section 33 establishes the first gear change shaft S8 on the extension wire of the main gear change driven shaft S7 which is a driving shaft. Two hydraulic clutches CH which set the first gear change shaft S8 as the rotational-motion force from the aforementioned main gear change driven shaft S7 to the first gear change shaft S8 concerned close and OFF, and CL While preparing Second gear change shaft S9 is prepared in parallel with the aforementioned first gear change shaft S8, close, two hydraulic-clutch CMs which carry out OFF, and CLL are prepared for the rotational-motion force from the aforementioned main gear change driven shaft S7 to the second gear change shaft S9 concerned in the second gear change shaft S9, and it constitutes possible [gear change] in four stages.

[0035] Thus, by constituting the subgear change section 33, the size of a cross direction is abbreviation half compared with the composition which arranges four subgear change clutches in series. Moreover, by considering the subgear change section 33 which is the gear change section located in an airframe posterior part as this composition A hydraulic clutch CH and CL A

common shaft (the first gear change shaft S8) can be set as the shaft established and the shaft with which a drive pinion G29 is formed. Compared with composition, the number of shafts becomes fewer conventionally which is indicated as a result, for example, aforementioned JP,61-58691,B, and while the number of parts is reduced and composition becomes simple, the size of the direction (the vertical direction) which crosses to shaft orientations (cross direction) is short. Furthermore, the hydraulic clutch CH by the side of the first gear change shaft S8 and CL It is possible also by having approached in the vertical direction and arranging hydraulic-clutch CM of second gear change shaft S9, and CLL to shorten further the size of the vertical direction of the subgear change section 33.

[0036] The "order ring uniform 4 **" state where the average rotational speed (peripheral velocity) of front wheels 2 and 2 and rear wheels 3 and 3 of the 4WD transfer device 34 is uniform velocity mostly, With the equipment which the average rotational speed of front wheels 2 and 2 changes to the "front-wheel accelerating 4 **" state which is twice [about] in a peripheral-velocity ratio, and the "rear wheel 2 **" state of cutting the drive of front wheels 2 and 2 and driving only rear wheels 3 and 3, to the average rotational speed of rear wheels 3 and 3 It has structure using the gear change mechanism of a wet multi-board hydraulic-clutch formula like the pre-go-astern gear change section 31 or the subgear change section 33. Moreover, the PTO gearbox 37 is equipment which changes gears PTO driving force to four stages, and has structure using the gear change mechanism of a locking-dog clutch formula.

[0037] As explained above, while the run gearbox of this tractor consists of the pre-go-astern gear change section 31, the main gear change section 32, and the subgear change section 33 and changing advance and go-astern by the pre-go-astern gear change section 31, the gear change position of a total of 16 steps is chosen with the combination of the main gear change by the main gear change section 32, and the subgear change by the subgear change section 33. The combination of the main gear change and subgear change has become as it is shown in Table 1.

[0038]

[Table 1]

変速位置	主変速 (油圧シリンダ)	副変速 (油圧クラッチ)
1	1速 (A プル)	超低速 (C _{LL} 入)
2	2速 (A プッシュ)	超低速 (C _{LL} 入)
3	3速 (B プル)	超低速 (C _{LL} 入)
4	4速 (B プッシュ)	超低速 (C _{LL} 入)
5	1速 (A プル)	低速 (C _L 入)
6	2速 (A プッシュ)	低速 (C _L 入)
7	3速 (B プル)	低速 (C _L 入)
8	4速 (B プッシュ)	低速 (C _L 入)
9	1速 (A プル)	中速 (C _M 入)
10	2速 (A プッシュ)	中速 (C _M 入)
11	3速 (B プル)	中速 (C _M 入)
12	4速 (B プッシュ)	中速 (C _M 入)
13	1速 (A プル)	高速 (C _H 入)
14	2速 (A プッシュ)	高速 (C _H 入)
15	3速 (B プル)	高速 (C _H 入)
16	4速 (B プッシュ)	高速 (C _H 入)

[0039] A hydraulic-clutch mechanism and the main gear change section 32 are synchromesh mechanisms, and the pre-go-astern gear change section 31 and the subgear change section 33 have composition which arranged the pre-go-astern gear change section 31 and the subgear change section 33 of a hydraulic-clutch mechanism in the transmission superior [of the main gear change section 32 of a synchromesh mechanism], and lower part side, respectively. Thus, it is unnecessary by combining the gear change section by the hydraulic-clutch mechanism, and the gear change section by the synchromesh mechanism to be able to cut power by the gear change section (the pre-go-astern gear change section 31 and subgear change section 33) by the hydraulic-clutch mechanism, in case the shift change of the gear change section (the main gear change section 32) by the synchromesh mechanism is carried out, and to prepare a clutch independently.

[0040] By the way, since variation arises a little in operation of an oil hydraulic cylinder which operates component parts and the main gear change shifters 56, such as a hydraulic system, according to conditions, such as few size errors of an oil pressure associated part, and hydraulic-oil temperature, the time which the shift change of the main gear change section 32 takes is not fixed. Therefore, the timing which turns off power by the gear change section by the hydraulic-clutch mechanism, and the timing

of a shift change of the main gear change section 32 do not suit, but in the main gear change section 32, a shock arises or clutch slipping of a hydraulic-clutch mechanism arises. It is performed as follows in order to make this influence small.

[0041] If power is turned off at the time of a shift change, the rotation by the side of a wheel will slow down by resistance from the ground. On the other hand, since the total reduction gear ratio before and behind a run gearbox becomes small compared with change before when carrying out a shift change at a high-speed range side, a shock is small even if both the aforementioned timing shifts somewhat. Therefore, in the pre-go-astern gear change section 31 which is the transmission superior side of the main gear change section 32, power is intercepted and a shift change is carried out. On the other hand, when carrying out a shift change at a low-speed range side, the difference of the total reduction gear ratio shift change before and after a shift change becomes large, since a shock is great, in the subgear change section 33 which is the transmission lower part side of the main gear change section 32, that both the aforementioned timing shifted for a while also intercepts power, and it carries out a shift change. Thus, it can choose whether according to the position which carries out a shift change, the power by the side of transmission superior is turned off, or the power by the side of the transmission lower part is turned off, and a smooth shift change is possible to every position by it.

[0042] Since it is the composition which carries out the shift change of each gear change sections 31, 32, and 33 with the actuator by which electromagnetic control is carried out, i.e., hydraulic-clutch CF, CB, CH, CM, CL, CLL, and oil hydraulic cylinders A and B, and controls each of that actuator by CPU, deviation does not arise to the timing of the ON OFF of the hydraulic clutch of the timing of a shift change of the main gear change section 32, the pre-go-astern gear change section 31, or the subgear change section 33, but

[0043] Since the main gear change section 32 is the structure which allotted the gear change gear of each stage to the order serial, it can shorten the length of a cross direction by constituting the main gear change section 32 from a synchromesh mechanism as compared with the case where this is constituted from a hydraulic-clutch mechanism. Moreover, as mentioned above, since the size is short also in the vertical direction, as for the subgear change section 33, these things to the whole gearbox is compact in it also at the cross direction. Furthermore, low-cost-ization is realized by adopting as the main gear change section 32 the synchromesh mechanism which structure can make simply and at a low price compared with a hydraulic-clutch mechanism.

[0044] The aforementioned gearshift lever 17 performs the change of a gear change position. As shown in drawing 7, a gearshift lever 17 is rotated forward and backward along the guide slot 18, and each actuated valve position of "the super-low one", a "rotary", "tilling before transplantation and a plough", "neutrality", and "a run" is prepared in the anterior in order from the posterior of the rotation range. The mode when working at super-low speeds, such as creep work, and a "rotary" "the super-low one" The mode at the time of rotary tilling work, If the mode of a run halt and "a run" are the modes at the time of a run on the street and, as for the mode at the time of tilling-before-transplantation work or plough work, and "neutrality", work (or run on the street) mode is chosen at a gearshift lever 17, "tilling before transplantation and a plough" Two or more steps (4-6 steps) of fields suitable for it which can be changed gears are set up. Furthermore, accelerating button 17a and slowdown button 17b which carry out finger operation are prepared in the grip of a gearshift lever 17, and it increase-slows down with these gear change buttons 17a and 17b in [aforementioned / which can be changed gears] a field.

[0045] For example, the field of a "rotary" which can be changed gears is step [5th] - the 10th step, and if a "rotary" is chosen with a gearshift lever 17, it will become first in the gear change position of the 7th step. And whenever it pushes accelerating button 17a once with the 7th step as the starting point, a number of speeds goes up one step at a time, and whenever it pushes slowdown button 17b once, a number of speeds falls one step at a time. The field which can be changed gears and origin number of speeds in each mode are as being shown in drawing 8.

[0046]

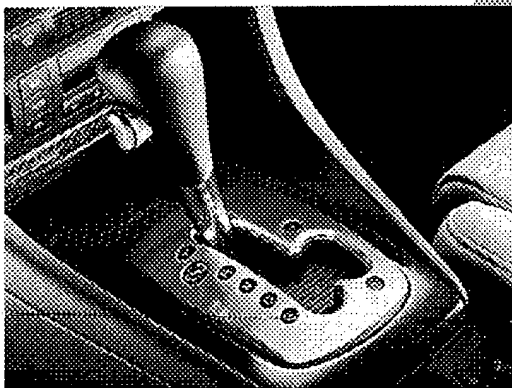
[Effect of the Invention] Miniaturization and low-cost-ization could be planned while becoming that a smooth shift change was possible, without preparing a clutch independently by considering as the composition which the gearbox concerning this invention arranges the gear change section by the hydraulic-clutch mechanism in a transmission superior [of the gear change section by the synchromesh mechanism], and lower part side, respectively, turns off the power of the gear change section by the hydraulic-clutch mechanism, and carries out the shift change of the gear change section by the synchromesh mechanism.

[Translation done.]

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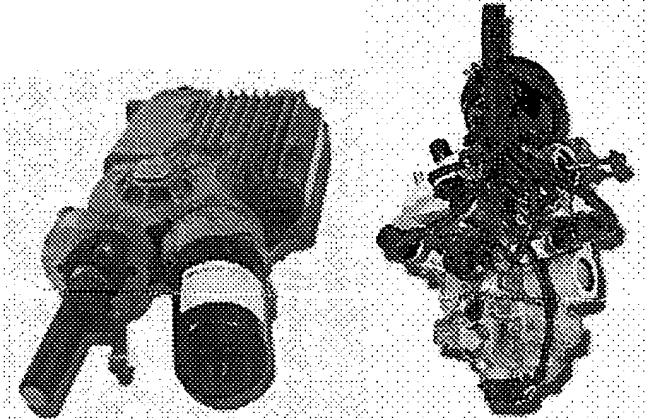
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